



## GENETICS & FARMING

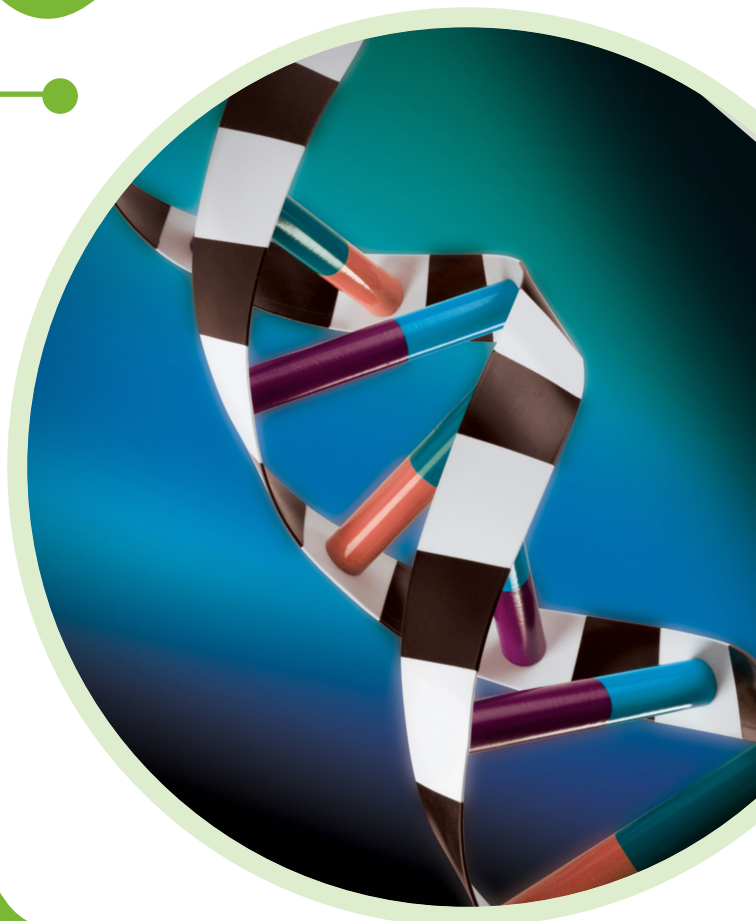
### LIFE'S ASSEMBLY INSTRUCTIONS

In the mid 20th century, scientists described a molecule found in the cells of all living things: deoxyribonucleic acid, or **DNA**. It had a distinctive double-helix shape, like a twisted ladder. The “rungs” of the ladder are made of four types of nitrogen-based molecules referred to by the letters A,T,G and C. These are the letters to write the “instruction book” of life itself. Combinations of these letters – genes – carry instructions for traits from height to hair colour, from seed size to frost tolerance, basically everything any organism needs to live and reproduce.

#### DNA is DNA<sup>1</sup>

It's easy to tell the difference among a fish, a flower, a human, and a chimpanzee. But at the DNA level, it's not so obvious. Eighty-five per cent of human genes are similar to those of zebrafish; for chimpanzees, it's a whopping 99 per cent.

The point is, there is no such thing as “fish DNA” or “tomato DNA.” It's all just DNA – genes that provide instructions for traits.



### KNOWING GENES ELIMINATES SOME GUESSWORK

About 10,000 years ago, people began to depend less on hunting and gathering or following their herds. As they moved less, they wanted their food close by. They replanted seed from plants they liked, ones with sweeter kernels or grains that didn't pop off before they could be harvested. It was the beginning of agriculture and of modern civilization.

For most of history, crop improvement was a slow, trial-and-error process. Farmers might try crossing a plant with big, sweet kernels with one that grew faster, but end up with something that grew slowly and produced small kernels. It took many tries to get what they wanted. Knowing about genes eliminates some of the guesswork and helps us identify plants with the traits we want. This lets us improve crops more quickly.



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## BOOKMARKS IN THE INSTRUCTION MANUAL

If crop developers know which genes go with desirable traits such as drought or pest resistance (assuming such traits exist) they can choose plants with those genes. They can also avoid plants with genes for undesirable traits such as low yield or susceptibility to disease. They still have to do the long and careful work of crossing plants together, tossing out crosses that don't work and carrying on with those that look promising – but knowing where the genes are and what they do speeds up the process.

Developers can test to see if genes for traits are present without having to actually grow the plants to find out. This is called marker-assisted selection.



In with the new,  
out with the old...  
**Hey! Wait a minute!**



## The **WORLD-WIDE WHEAT** project<sup>2</sup>

A genome is all of the thousands of genes in an organism. Wheat's genome is five times larger than humans and carries a lot of duplication. Finding out where its genes are and what they do is sort of like indexing three different encyclopaedias – and figuring out which one is actively being used.

Researchers around the world tackled the problem, publishing the first draft of the wheat genome in 2017.

Wheat is the most widely-cultivated staple food crop in the world, covering 215 million hectares in nearly 90 countries (that's more than three times all of the farmland in Canada!). According to the International Maize and Wheat Improvement Centre, we're going to need to grow 60 per cent more wheat to feed the world in the next 30 years.

**WHAT if crop developers are faced with a new disease or changing climate?**

**WHAT if people demand different taste and texture?**

Developers can't work on everything at once, so they carefully record the traits of different varieties and set them aside in case they need them.

The University of Saskatchewan has samples of wheat going back 100 years. Seeds also go into reference libraries such as Plant Gene Resources Canada or the Global Seed Vault at Svalbard, Norway, high above the Arctic Circle – just in case.

